REMARKS

The Official Action of October 16, 2007 has been carefully considered and reconsideration of the application is respectfully requested.

Claims 1-4, 6-8, 9-12, 14 and 15 stand rejected under 35 USC 103(a) as allegedly being unpatentable over Rodriguez et al. Claim 5 and 13 stand rejected under 35 USC 103(a) as allegedly being unpatentable over Rodriguez et al in view of Panepinto. Applicants again respectfully traverse these rejections.

The claimed invention is based at least in part on Applicants' discovery that water of high salinity, such as sea water which is normally not suitable for leather processing, may be used in an initial (soaking) operation if the soaking in the saline water is done in the presence of a salt of an alkali metal or alkaline earth metal. This is clearly defined in steps i) and ii) of claim 1. Leather processing is water intensive and the present invention provides an option to use readily available seawater for leather processing.

Salinity has been defined in the site (http://www.nrw.qld.gov.au/salinity/whatis.html) as the presence of soluble salts in soils or waters. It is a general term used to describe the presence of elevated levels of different salts such as sodium chloride, magnesium and calcium sulfates and bicarbonates, in soil and water. As discussed previously, saline water such as sea water is used in the process of the present invention.

Saline water, contains ions such as calcium (Ca^2), magnesium (Mg^2), sulfate (SO_4^2), bicarbonate (HCO_3), in addition to sodium and chloride, and other compounds. (http://waterquality.montana.edu/docs/methane/saline-sodic

Obviously, saline water contains a number of different ions and its content is not limited to sodium chloride. Rodriguez, et al. used sodium chloride ("brine") for leather making. The calcium and magnesium salts, as is known in the art, react with the constituents of the hide/skin and prevent rehydration of the hide/skin. This has been obviated in the present invention by using salt of alkali metal or alkali earth metal in the step (i). Clearly, Rodriguez does not teach

the use of saline water containing 11, 000 to 3,000 ppm of chlorides and i) treating a rawhide or skin with not less than 300% w/v of saline water containing11000 to 30000 ppm of chlorides, in the presence of not less than 0.04%w/v of salt of an alkali metal or alkaline earth metal, either individually or in any combination thereof, for a period of not less than 12 hours to obtain soaked hides/skins, ii) treating the hide or skin with not less than 2% w/w of alkali metal in combination with not more than 200% w/v of saline water for a period of not less than 6 hours. (Emphasis added)

Rodriguez does not suggest the use of multiple metals as is illustrated by the examples.

According to the Examiner, it would be obvious to one of ordinary skill in the art to substitute other salts such as calcium hydroxide for sodium hydroxide because they are well known in the art to be used for unhairing as taught by Panepinto.

This is to clarify that while Panepinto discloses a process of dehairing using hydroxide of sodium and potassium, the present invention involves only soaking (rehydration) of a hide or skin in presence of a salt of alkali metal or alkali earth metal; it does not involve dehairing. Hence, Panepinto's teaching is irrelevant to the subject matter of the claims.

In view of the above, it is respectfully submitted that all rejections and objections of record have been overcome because the claims are not obvious and that the application is now in allowable form. An early notice of allowance is earnestly solicited and is believed to be fully warranted.

Respectfully submitted,

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Queensland Government

Natural Resources and Water

Land management

Home → Topics → Land management → Salinity

What is salinity?

Salinity is the presence of soluble salts in soils or waters. It is a general term used to describe the presence of elevated levels of different salts such as sodium chloride, magnesium and calcium sulfates and bicarbonates, in soil and water. It usually results from water tables rising to, or close to, the ground surface.

- Types of salinity
- Contributing factors
- Salinity indicators
- Adverse effects
- Preventing salinity problems
- Managing salinity

Types of salinity

The three main types of salinity are:

- dryland salinity, which is caused when saline seeps scald the surface of non-irrigated lands, in turn affecting plant growth and degrading soil structure
- irrigation salinity, which results when overuse of water for irrigation causes rising watertables
- saltwater intrusion, which occurs in coastal aquifer systems where sea water replaces groundwater that has been over-exploited.

Contributing factors

The occurrence of salinity depends on several factors, the most important of which are:

- the characteristics of the landscape
- the climate
- the effects of human activities.

An understanding of water movement associated with the salt-affected area is needed to determine the likely extent of any problem.

The sources of these salts are:

- rainfall, which carries low concentrations of salts that have accumulated in the atmosphere over thousands of years
- weathering and erosion of surface rocks
- groundwater that has soaked through sediments and sedimentary rocks that originally formed in salty marine environments.

The amount of salts that accumulate in soil depends on the properties of the soil and rainfall, with clay soils (which occur extensively in inland Queensland) generally having the highest levels.

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Salinity indicators

Signs to look out for include:

- a ground surface that is becoming permanently or seasonally damp or waterlogged, or remains damp after extended rain
- intermittent streams that flow for longer periods
- dieback of vegetation in low lying areas, or failure of plants to germinate or grow
- areas of bare soil or an increase in salt-tolerant plants in an area
- changing pasture composition and reduced diversity (with couch grass and other salt tolerant plants dominating)
- rising damp in buildings
- deterioration in the quality of surface or groundwater
- road deterioration and crumbling
- rising groundwater levels in bores.

Adverse effects

Some land-use activities cause the watertable to rise and thus carry salts closer to the surface or into surface water systems. These include excessive irrigation, and clearing of deep-rooted vegetation such as native trees and grasses.

This can:

- retard or kill crops and vegetation
- increase soil erosion
- increase salt pollution of rivers and dams, harming water supplies for drinking and irrigation.

Rising salty watertables can damage roads, fences, railways and buildings and harm natural ecosystems.

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Preventing salinity problems

In areas where a salinity hazard map identifies a high level of hazard:

- monitor groundwater levels and the amount of salt in the land and water
- encourage preventative actions by landholders to stop salt moving towards the surface
- stop the further loss of deep-rooted native vegetation both in high-hazard areas and in those areas that contribute groundwater to them.

Specific methods of prevention include:

- retaining and regenerating native vegetation
- avoiding building dams at sites where the watertable is high
- locating roads along ridges where disruption to water tables will be minimal
- siting houses (and septic systems) away from areas with high watertables
- maintaining good pasture cover through conservative stocking rates
- adopting high water efficiency cropping practices which minimise deep drainage.

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Managing salinity

Managing salinity involves striking a balance between the volume of water entering the groundwater system (recharge) and the volume of water leaving it (discharge).

The watertable can be lowered by:

- planting, regenerating and maintaining native vegetation and good ground cover in recharge, transmission and discharge zones, where possible
- increasing groundwater use in recharge areas by pumping water from bores and by using drainage to redirect water to other storages
- installing bores and interceptor drains in discharge areas—water of suitable quality can be used to irrigate adjacent areas
- installing sub-surface drainage
- maximising cropping opportunities and minimising fallow land.

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THE DEPARTMENT OF LAND RESOURCES AND ENVIRONMENTAL SCIENCES
WATER QUALITY & IRRIGATION MANAGEMENT

Frequently Asked Questions

Saline and/or Sodic Water and Soils

PDF

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RECLAMATION OF SALINE AND/OR SALTY SOIL AND WATER

What can be done to manage or reclaim a saline or sodic soil?
Can anything be added to saline and/or sodic water to "treat" (or clean) the water?
Will elemental sulfur or gypsum reclaim a saline and/or sodic soil?

INFORMATION ON SALINE AND/OR SODIC WATER

What is saline water and why is it defined as saline?

Water is classified as "saline" when it becomes a risk for growth and yield of crops. Saline water has a re concentration of dissolved salts (cations and anions). Salt is not just "salt" as we know it - sodium chlori can be dissolved calcium (Ca^{2+}), magnesium (Mg^{2+}), sulfate (SO_4^{2-}), bicarbonate (HCO_3^-), Boron (B), : compounds.

Salinity of water is referred to in terms of total dissolved solids (TDS), but salinity is actually approxima measuring the electrical conductivity (EC) of water, expressed in decisiemens per meter (dS/m) or less o millimhos per centimeter (mmhos/cm) (the two measurements are numerically equivalent). TDS is relate following equations:

- TDS (parts per million, ppm or milligrams per liter, mg/L) = 640 x EC (dS/m)
- TDS (milliequivalents per liter) = 10 x EC (dS/m)

The U.S. Department of Agriculture defines water with an EC greater than 4.0 dS/m as saline. The hortic frequently uses a standard of 2 dS/m to define saline water.

What is a sodic water and why is it defined as sodic?

Sodic water is high in sodium (Na^+) concentration relative to concentrations of calcium (Ca^{2+}) and magı The sodicity of water is expressed as the sodium adsorption ratio (SAR),

$SAR = Na / \sqrt{[(Ca + Mg) / 2]}$ (These values are in meq/L)

$SAR = (Na \times 0.043) / \sqrt{\{[(Ca \times 0.05) + (Mg \times 0.083)] / 2\}}$ (These values are in ppm or mg/L)

Sodic water is defined as having a SAR greater than 12.

Can a water source be both saline and sodic?

Water can be both saline and sodic, or saline-sodic. If water has an EC greater than 4 (2 for horticulture) greater than 12, it is considered saline-sodic.

What causes a water source to be saline or sodic?

Water can naturally become saline or sodic by coming into contact with soil or geologic material that is high in salts. Upon contact, salts dissolve into the water, raising the EC and/or the SAR of the water. Water can also

become saline when evaporation concentrates naturally occurring salts.

What is a saline seep?

If water is introduced to an upland site in a watershed and is not removed by plant uptake, it could move root zone, travel down slope, and surface at a low spot in the watershed. In some geologic formations (e soils formed from glacial till or stratified marine deposits) water percolating through the soil dissolves s soil. Once the water reaches a compacted layer or a zone of much greater horizontal conductivity, it can laterally until it surfaces at a low spot in the watershed either as saline potholes or seep sites. This proce saline seep. For more information, see the Montana Department of Natural Resources and Conservation.

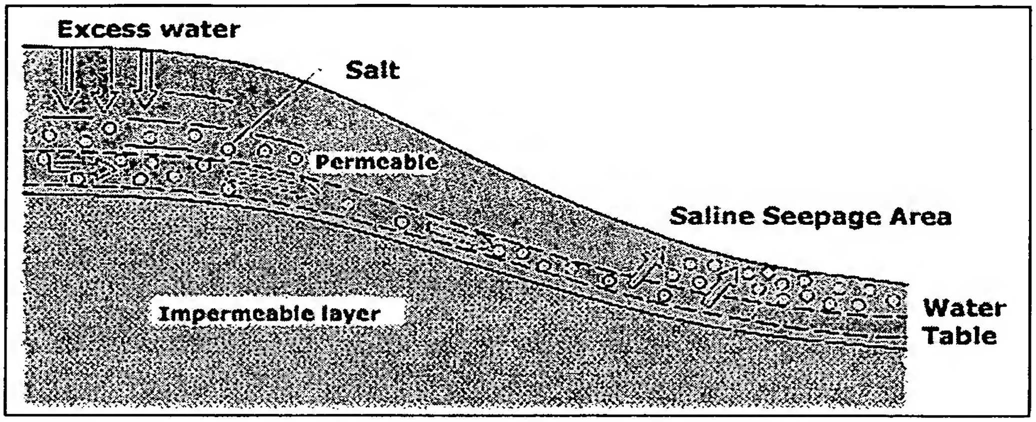


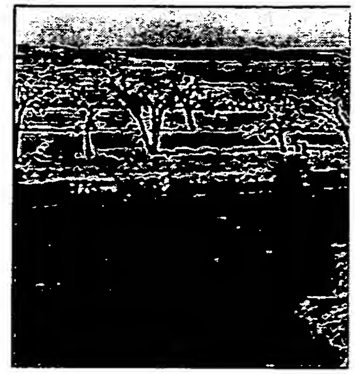
Figure source: www.agr.gc.ca/pfra/ pub/prairiesoils_e.htm

What is water alkalinity?

Alkalinity is the ability of water to neutralize acids or buffer the water from change in pH. Alkalinity is r determining the concentration of bicarbonate (HCO_3^-), carbonate (CO_3^-), and hydroxide (OH^-) and is re concentration of calcium carbonate ($CaCO_3$) equivalent to the sum of the carbonate, bicarbonate and hy buffered surface water systems have alkalinity of 20 to 300 ppm. Commercially available meters or test used to test alkalinity.

What is the salinity of rivers and streams in Montana?

In surface water systems (rivers, lakes, streams, etc.), the TDS varies from as low as only a few hundred parts per million (or milligrams per liter) in many western mountain areas, to as much as 2500 to 3000 parts per million (mg/L) during the lowest flow periods in some of the smaller prairie streams of eastern Montana. If you are interested in variability in TDS of a stream in your area, the United States Geological Survey has an extensive database of historical water quality information on streams and rivers across the U.S.



What is the relationship between stream flow and EC, and between stream flow and SA
Generally, salinity decreases as stream flow increases and increases with decreasing stream flow. The sa SAR. In many high plains streams, salinity may rise with the first flush of runoff water due to bank flush washes salt off the soil adjacent to streams. Stream flow generally decreases after spring snow melt and r higher elevations ends. When the river goes through rising and falling stages due to rain (especially thun EC is usually lower when the river level is falling, rather than rising. For a good report on this topic read Publication "U.S. Geological Survey Monitoring of Powder River Basin Stream Water Quantity and Qua

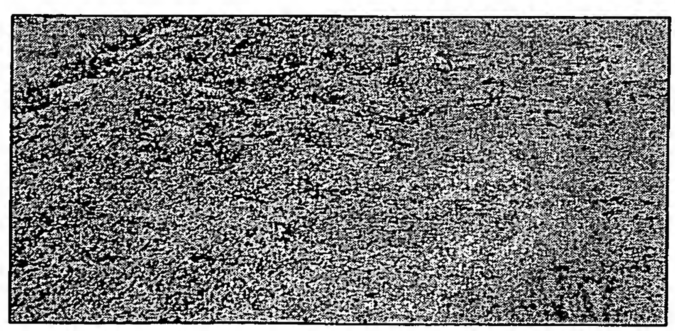
The EC of stream water may also increase during periods of drought and during the irrigation season fro irrigation return flow.

The SAR of a stream is dependent on the amount of sodium in the stream relative to the amount of calciu magnesium. If sodium is a significant component of irrigation return flow, the SAR of the stream could i low flow. Similarly, if evaporation is extensive, this may also cause SAR to increase due to concentratio precipitation of calcium as limestone.

INFORMATION ON SALINE AND/OR SODIC SOILS

What causes a soil to be saline and/or sodic?
Saline soils are indicative of inadequate drainage to leach salt from the soil or upward migration of salt ground water. Sodic soils have an abundance of sodium. Some soils are naturally saline and/or sodic. If formed on parent material high in salts, such as marine deposits, and it has inadequate drainage, the soil in salts as well.

Soils can become saline and/or sodic from unnatural processes as well. Fertilizers, soil amendments (gypsum or lime), and manure may contribute to soil salt problems. Applications of saline and/or sodic water without adequate leaching or in the presence of a high water table will increase soil EC over time, eventually resulting in saline soil. Soils can also become saline through the process of saline seep.



Poorly drained soils, such as near a stream or river plain, can become saline and/or sodic over time, esp irrigation or in the presence of abundant water or shallow water tables. Careful attention must be paid tc to avoid accumulation of salts where net water movement is upward due to rising water tables, excessiv or excessive plant water use without drainage.

How do I measure soil salinity and sodicity?

It is generally agreed upon among soil scientists that salinity of the soil saturated paste extract most clos conditions faced by plants. The general guideline is that the soil saturated paste extract will be equal to b 3 times the salinity of the applied irrigation water and generally will be less saline than what the plant is

The device used to measure salinity of water is an EC meter. With the right soil water mixtures, they can measure salinity of soil as well. However, only a lab can measure the sodicity, or SAR, of irrigation wat county Extension or United States Department of Agriculture, Natural Resource Conservation Service (I offices will have information on purchasing or borrowing meters, as well as information on labs in your

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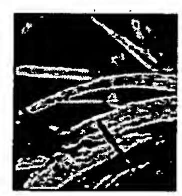
What is an adjusted SAR?

The SAR of groundwater and soil water may need to be adjusted to account for changes in the chemistry when it comes in contact with soil. This change can be caused by calcium precipitation. The actual conc calcium in soil water may be lower (or sometimes higher) than that of the irrigation water. In soils, disso ions will become insoluble in the presence of the carbonate (CO_3^-) in the applied water. Calcium and ca combine to form limestone. Thus, following irrigation, the concentration of soluble calcium in the soil m than that of the irrigation water. It is generally safe to assume that the SAR experienced by the soil will t greater than the SAR of the irrigation water, due primarily to calcium precipitation.

How do I know if I have a problem with saline and/or sodic soils?



Often the problem is obvious. Excess soluble salts will often crystallize on the surface of fallow fields, while thin, patchy salt crusts will form under clods or on the shady side of clods where marginal salt problems are found. Thick, continuous crusts form in saline seeps. Saline soils tend to inhibit germination and emergence of plants. Therefore, patterns of growth in cropped fields will be poor, with spotty stand establishment. Under severe salt stress, herbaceous crops appear bluish-green; leaf tip burn and die-off of older leaves in cereal grains can result from salinity or related drought stress.

Where do saline and sodic soils occur in Montana?

The most common locations to find saline soils are in the eastern and central part of Montana and in poo areas north of the Missouri River. Naturally saline soils are found along many stream terraces and bottor seeps can be found throughout most of the glaciated plains region. Sodic soils occur in many of the same saline soils, found most commonly in eastern and north central Montana and along irrigated flood plains

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SALINITY, SODICITY, AND CROP PRODUCTION

What are the common problems or difficulties with the use of saline water for irrigatio

Saline water reduces plant growth, making irrigation with it risky if not managed properly. With time, sa saline water may accumulate in the root zone to concentrations high enough to affect crop growth by red availability of water. Just 1 acre-foot of irrigation water of moderately saline quality (EC = 2 dS/m - the suitability for irrigation water) will introduce 1.8 tons of salt per acre of land. Soluble salts do not leach a fine textured soils as in sandy soils; therefore, it is critical to add enough water to meet crop water requir maintain net downward movement of water through the soil.

What is the tolerance of common Montana crop and forage species to saline irrigation w

Table 1 illustrates salt tolerance levels for some common Montana crops.

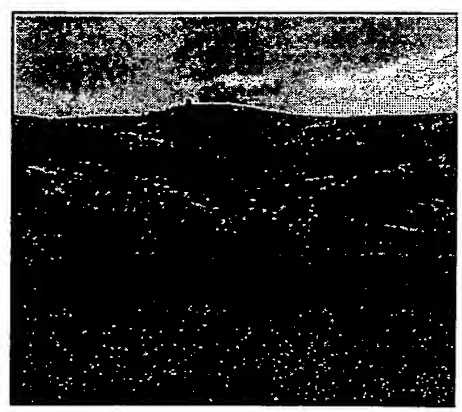
Table 1. Salt tolerance for common Montana crops.

	Tolerant [1]EC = 10-16	Semi-Tolerant [1]EC = 4-10	Sensitive [1]EC < 4
Crops	Barley Sugar beet Sunflower	Wheat Oats Safflower Corn	Potatoes Field bean Peas Lentils
Forages	Tall wheatgrass (Alkar) Bearless wildrye (Shoshone) Altai wildrye (Prairieland) Slender wheatgrass (Revenue) Western wheatgrass (Rosana) Russian wildrye (Commercial) Barley (Steptoe)	Yellow sweetclover (Commercial) Alfalfa (ladak 65) Tall fescue (Kenmont) Wheat (hay) Orchardgrass Cicer milkvetch Crested wheatgrass (Nordan)	White clover Meadow foxtail Alsike clover Red clover Ladino clover

Source: MSU Extension Montguide #8382 *Salinity Control Under Irrigation* and MontGuide MT8321 "Salt Tolerant Forages for Saline Seep Areas"

[1]*Electrical Conductivity (dS/m)*

How does saline water affect alfalfa growth?

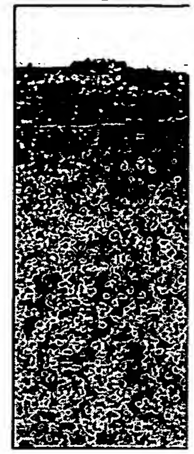


Saline water reduces plant growth to varying degrees, with grass and grain crops generally showing less sensitivity and field crops being most sensitive. Aside from biomass reduction, salinity can have additional effects on plants. For example, in a study by Bauder et al., both inoculated and non-inoculated alfalfa were grown with irrigation waters of progressively higher salinity levels (Figure 1). Alfalfa nodulation (ability to fix atmospheric nitrogen) was reduced and actual weight and number of nodules decreased when plants were irrigated with moderately saline water. Growth of alfalfa plants was also inhibited, even with nitrogen fertilizer application. Growth of alfalfa decreased linearly with each increase in irrigation water salinity. Increasing salinity of irrigation water caused a greater decrease in yield for non-inoculated alfalfa than for inoculated alfalfa.

What's a recommended irrigation strategy to reduce salt injury to seedlings?

On new plantings of grass, legumes, small grains, corn, and sorghum, shorten the set times early in the s plants are small, and irrigate more frequently. Maintaining a fairly moist soil during early growth will re: stand, better early growth, and an increase of as much as 25% in overall yield.

What are the common problems or difficulties with the use of sodic water for irrigation



Elevated sodium and chloride concentrations in water can harm some woody plants due to direct toxicity as ions are taken up by the root cells or applied directly to the leaves. Either way, ions can accumulate in the leaves, causing burn along the outer leaf edges. In addition, sodium can indirectly affect crop growth by causing calcium, potassium, and magnesium deficiencies or by adversely affecting soil physical properties.

In addition to being a salinity component of irrigation water, sodium poses a more troublesome problem in soils containing more than 30% of a swelling type clay. On such soils, sodium changes soil physical properties, leading to poor drainage and crusting, which can affect crop growth and yield. Irrigation with sodic water on sandy soils does not cause crusting and poor drainage, as the sodium is more readily leached from the soil profile. However, if the water is saline-sodic, crop growth and yield may be compromised on sandy soils.

What are guidelines for the suitability of irrigation water quality relative to soil dispers crusting, and swelling?

Table 2 illustrates guidelines for irrigation water quality relative to risk of soil dispersion, crusting, and s

How to use this table: the three pieces of information you will need are: 1) the amount and type of clay i the salinity (EC) or TDS (mg/L) of your irrigation water; and 3) the SAR of your irrigation water. If you than 30% clay or does not contain a swelling-type clay, risk of dispersion, crusting, and swelling caused water is minimal. To determine risk, first select the SAR range which applies to your irrigation water, i.e 6-12. Within that range, select the EC or TDS that applies to your irrigation water. Then read across the SAR x EC or TDS combination to the far right column, which indicates the risk of soil dispersion, crusti swelling.

Table 2. Water quality guidelines for risk of dispersion, crusting and swelling of soils w more than 30% swelling clay.

	Major Parameter		
SAR	EC (dS/m or mmhos/cm)	TDS (mg/L or ppm)	[1]Risk of Soil Dispers Crusting, Swelling
0-3	less than 0.2	less than 128	Very High
	0.2-0.7	128-428	Moderate
	greater than 0.7	greater than 428	Low
3-6	less than 0.3	less than 192	Very High

	0.3-1.2	192-768	Moderate
	greater than 1.2	greater than 768	Low
6 - 12	less than 0.5	less than 320	Very High
	1.9-0.5	320 - 1216	Moderate
	greater than 1.9	greater than 1216	Low
12 - 20	less than 1.3	less than 832	Very High
	2.9 - 1.3	832 - 1856	Moderate
	greater than 2.9	832-1856	Moderate
20 - 40	less than 2.9	less than 1856	Very High
	2.9 - 5.0	1856 - 3200	Moderate
	greater than 5.0	greater than 3200	Low

Values of EC in dS/m are numerically the same as mmhos/cm; multiply by 1000 to get equivalent values for umhos/cr total dissolved solids, which is equal to EC x 640; values are parts per million (ppm) or mg/L.
Source: Western Fertilizer Handbook Table 2-5 and Figure 2-6.

[1/]Risk of dispersion, swelling, and crusting applies especially to soils with more than 30% clay: cl silty clay loam, sandy clay loam, or silty clay textural classes.

What is the suggested range in EC and SAR of irrigation water for soils of varying text
Table 3 lists suggested ranges in irrigation water EC and SAR for different soil textures.

Table 3. Suggested ranges in irrigation water EC and SAR for different soil textures.

Clay Content	Soil Texture	EC (dS/m)		SA	
		Flood	Sprinkler	Flood	S
Less than 30%	very coarse (sand, loamy sand)	0 - 4	0 - 5	N/A	
Less than 30%	coarse (sandy loam)	0 - 3	0 - 4.5	12 - 15	
Less than 30%	medium (loam, silt loam)	0.2 - 2.5	0 - 3	12 - 15	
Greater than 30%	medium fine (clay loam, sandy clay loam)	0.5 - 2.9	0.3 - 2.9	6	
Greater than 30%	fine (silty clay loam, clay, sandy clay, silty clay)	0.5 - 1.9	0.3 - 29	6	

Source: Modified from Western Fertilizer Handbook

How often and when should one measure the EC and SAR of irrigation water?

The timing and frequency of measuring the EC and SAR of irrigation water really depend on the flow an water source. If the water source is constant (such as a well, lake, pond, or large river), the water should minimum during the lowest flow volume when water is to be used for irrigation and at the beginning of t season. If the source is a cyclic stream or river, the water should be tested any time flow has been low an long period of time. The best rule of thumb is to measure when flow is representative of irrigation water has been a significant change in flow.

How often should one measure the EC and SAR of soil in a crop field?

Because sodium affects soil textures differently, it is necessary to have the soil sent to the lab for a textu percent sand, silt and clay. This analysis need only be done one time. If the soil or irrigation water is of r quality, the soil should be tested annually for EC and SAR prior to crop planting (have the lab test EC ar they test for nutrients). Data should be compared to previous years to determine the trend of EC and SAI proper management practices are being performed, the trend should be downward or constant. For more soil sampling and for a list of soil testing labs in your region, go to MSU Nutrient Management Informat Select "Module 1: Soil Sampling and Laboratory Selection" and refer to page 8.

Are there enforceable standards or thresholds for salinity and sodicity of water used fo

There are no Federal standards for irrigation water quality enforceable by law. Even in the case of surfac designated for irrigation use under the Clean Water Act, there are no enforceable numerical salinity stan only a recommended threshold of EC and SAR for irrigation water suitability. In some cases, enforceabl being developed as part of the Total Maximum Daily Load (TMDL) process under the Clean Water Act some other condition necessitates standards.

What is the best strategy for irrigating with water from rivers and streams in semi-arid flow high in the spring and may even go dry in mid-summer?

First, review all available flow and water quality data (start with the United States Geological Survey we contact your state water quality agency), or begin collecting your own flow and water quality data. A rev historic water quality and flow records should indicate several changes throughout the year. Knowledge changes may help you manage the irrigation water. In addition to testing irrigation water for EC and SA] question) use the following guidelines when irrigating:

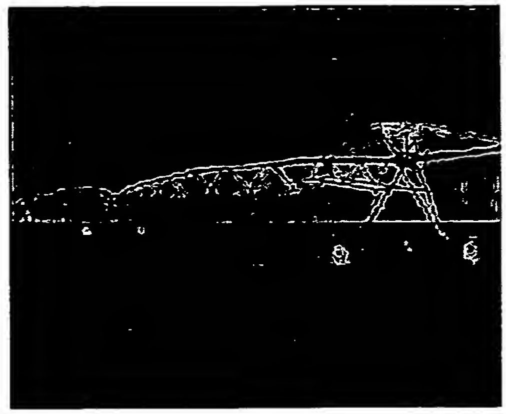
1. Fill the profile as early as possible after the peak flow stage, or as soon after forage harvest as pos peak flow, salinity levels are low, but sediment is high. Sediment generally tends to decrease dram peak flow.
2. If at all possible, delay irrigation until after the peak flow period. Begin irrigating as the flow level Salinity and sediment levels tend to be lower on the falling stage than the rising level of the strean
3. Some sediment in the water will help move the advancing wetting front across border-dike, gradec and furrow irrigated fine sandy loam soils.

Is there a threshold stream flow at which one should stop irrigating?

There is no minimum flow at which one should stop irrigating. A person should measure the EC of the w determine irrigation suitability.

How can one safely use saline water for irrigation?

Modestly saline water can often be used successfully in the right soil x crop combination without hazard· effects on the crops or soils. However, certain conditions need to be met:



- The soil being irrigated must be well-drained.
- Salt tolerant crops (established alfalfa, barley, sorghum, sudan grass, sordan) should be grown.
- Rotations should be planned to provide for a sequence of progressively more salt tolerant crops.
- Salts should be leached out of the soil in the spring or winter.
- As salinity of either the irrigation water or soil solution increases (with prolonged crop water use and through the irrigation season), the volume of irrigation water applied should be progressively increased.

Adoption of new crop and water management strategies can further facilitate use of saline water for irrig strategy is to substitute more saline water (later in the irrigation season) for good quality water to irrigate in the rotation or well-drained soils. Salt buildup that occurs from irrigating with saline water can be redı following winter or spring from rainfall or irrigation with low-salinity water.

Soils do not usually become excessively saline in a single irrigation season. It often takes several season: salt level in the soil. The maximum soil salinity in the root zone that results from continuous irrigation w does not occur when salty water is used only a fraction of the time.

How long does it take for the effects of irrigation with saline water to be evident in the s

Soils do not usually become excessively saline from use of saline water in a single irrigation season. It m several irrigation seasons to affect the level of salt in the soil solution. The maximum soil salinity in the ı results from continuous irrigation with saline water does not occur when salty water is used only a fracti

The only way to be certain of the impacts of saline irrigation water on the soil is to periodically sample a water and the soil. Although soil testing will provide a general guideline of the effect irrigation water mi on soil quality, the chemistry of the soil will only reflect the chemical content of irrigation water after se seasons. Irrigators should realize that groundwater quality can change with time and surface water qualit seasonally; surface water tends to become more saline as stream flow declines. If an irrigator is going to for testing, the sample should be collected after the well or supply has been pumped for some time and tl should be placed in a clean container.

RECLAMATION OF SALINE AND/OR SALTY SOIL AND WATER

What can be done to manage or reclaim a saline or sodic soil?

Reclamation of saline or sodic soils can be done. It is first necessary to know whether the soil you want t saline, sodic, or both, since reclamation procedures are different for each.

Saline soil reclamation requires as a minimum: 1) assessment of the problem, 2) enhanced drainage, and salt free water supply. Without these components, reclamation cannot progress.

Saline soil reclamation requires leaching the soil with enough non-saline water that salts are moved belo

zone. Adequate drainage is absolutely necessary for this procedure to be successful. Research in the wes States has shown that substantial water volumes are needed to leach salt from the soil. Application of rec by sprinkler irrigation or repeated pulsing of small applications of water (as opposed to flood irrigation) method, as leaching is more thorough in an unsaturated soil. Whether leaching with a sprinkler or a flooc system, testing the soil for EC following treatment will help assess the effectiveness of reclamation.

Sodic and saline-sodic soils often are or will become impermeable to water. Therefore, a soil amendmen water is necessary to start the reclamation process. Following the soil amendment, one can apply water i described for saline soils (above). The amendment, either directly or indirectly, provides a mechanism to sodium from the soil. Adequate drainage is then necessary for the water to move the sodium and other sa system. If a soil is sodic, an alternative reclamation option is irrigation with saline water with at least 30 salt being calcium and magnesium.

Can anything be added to saline and/or sodic water to "treat" (or clean) the water?

There are no amendments, chemicals, or additives available commercially that can be added to saline wa salt go away. Dilution with a non-saline water or salt precipitation with an evaporation process which lea behind and traps the evaporated water can be used. Dilution of saline irrigation water is only possible if t of non-saline water with which to dilute the saline water. The evaporation and salt precipitation treatmen not be economical or feasible with large quantities of saline irrigation water.

It is possible to alter the chemistry of sodic water by adding calcium and magnesium. This will not elimi the sodium, but will change the ratio of sodium to other salts. The net result is more saline water; sodium "neutralized."

Will elemental sulfur or gypsum reclaim a saline and/or sodic soil?

Gypsum is generally added to provide a calcium source to displace sodium in the soil. (Gypsum is calciu 22.5% calcium). For most soils in Montana east of the continental divide, the soil is already saturated wi calcium (as calcium carbonate or lime). Hence, adding gypsum to a soil already saturated with calcium s the concentration of calcium, favoring formation of calcium carbonate.

Elemental sulfur can be used as an amendment at high rates (500-1000 pounds per acre). On soils in Moi the continental divide, sulfur is added to stimulate microbial action and formation of sulfuric acid, which pH decreases, lime is dissolved, and calcium and magnesium replace sodium in soils. However, without drainage and good water to move the sodium out of the soil, little reclamation is gained by adding sulfur

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For further information:

Frequently Asked Questions - Coal Bed Methane
Basics of Salinity and Sodicity Effects on Soil Physical Properties

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